

Historic, archived document

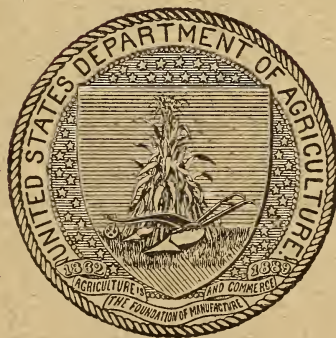
Do not assume content reflects current scientific knowledge, policies, or practices.

JUN 21 1903

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF FORESTRY—BULLETIN No. 40.
GIFFORD PINCHOT, Forester.

A NEW METHOD
OF
TURPENTINE ORCHARDING.

BY
Dr. CHARLES H. HERTY,
EXPERT.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1903.

BUREAU OF FORESTRY.

GIFFORD PINCHOT, *Forester.*

FOREST MANAGEMENT,

OVERTON W. PRICE, *in Charge.*

FOREST INVESTIGATION,

GEORGE B. SUDWORTH, *in Charge.*

FOREST EXTENSION,

WILLIAM L. HALL, *in Charge.*

FOREST PRODUCTS,

FREDERICK E. OLMSTED, *in Charge.*

RECORDS,

OTTO LUEBKERT, *in Charge.*

**United States
Department of
Agriculture**



National Agricultural Library

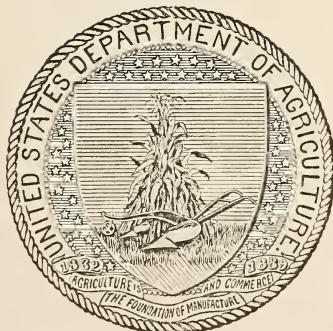
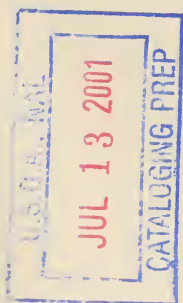


CUP AND GUTTERS USED IN COLLECTING CRUDE TURPENTINE.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF FORESTRY—BULLETIN No. 40.
GIFFORD PINCHOT, Forester.

A NEW METHOD
OF
TURPENTINE ORCHARDING.

BY
Dr. CHARLES H. HERTY,
EXPERT.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1903.

LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF FORESTRY,

Washington, D. C., February 9, 1903.

SIR: I have the honor to transmit herewith a report entitled "A New Method of Turpentine Orchardng," by Dr. Charles H. Herty, expert in the Bureau of Forestry, and to recommend its publication as Bulletin 40 of this Bureau. The accompanying fifteen plates and five text figures are necessary to a clear understanding of the subjects discussed in the report.

Very respectfully,

GIFFORD PINCHOT, *Forester.*

Hon. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

	Page.
Critical condition of the naval-stores industry	9
The present method of turpentine orcharding	9
The box system	10
Box cutting	10
Cornering	10
Chipping	10
Dipping	11
Scraping	11
Raking	11
The crop	11
Drifts	12
Distillation	12
Chief evil of the box system	12
Necessary requirements in an improved system	14
Earlier substitutes for the box system in the United States	15
Turpentine gathering in France	15
History of present investigation	16
Preliminary experiments	16
Cup and gutter system in operation	17
Scope of the test	18
Results	20
First-year crop ("virgin")	21
Reasons for excess yield from cupped trees	24
Second, third, and fourth year crops	29
Dippings	29
Cost of cup equipment for one crop	31
Division of labor	32
On virgin timber	32
On old boxes	32
Cups	33
Size and form	33
Material for cups	33
Gutters	34
Best material	34
Form of material	34
Shaping gutters	34
Gutter boxes	35
Placing gutters	35
Tools for placing equipment	36
Cornering ax	36
Broadaxes	36
Claw hatchet	36

	Page.
Operating with the equipment	36
Chipping	36
Pulling	37
Dipping	37
Tool used	37
Method of dipping	37
Cost of dipping	37
Removal of equipment	38
From high faces	38
From low faces	38
Cost of removal	38
Cost of raising the equipment	39
Scraping	39
Scrape box	39
Scraping third-year and fourth-year trees	39
Disturbance of equipment	39
Height of equipment	40
Daily flow of resin	40
Comparison of resin from boxed and unboxed timber	41
Conclusion	42
Progress resulting from the investigation	42
Future investigations	42
Acknowledgment	43

ILLUSTRATIONS.

PLATES.

	Page.
Cup and gutters used in collecting crude turpentine.....	Frontispiece.
PLATE I. Fig. 1.—Cutting a box. Fig. 2.—Cornering a box.....	12
II. Fig. 1.—“Chipping.” Fig. 2.—Dipping crude turpentine from a box.....	12
III. Fig. 1.—Formation of “scrape” on a high face. Fig. 2.—Wasting resin from a leaning tree.....	16
IV. Boxed sapling pine blown down at beginning of season.....	16
V. Fig. 1.—Effect of slight storm on “back-boxed” timber. Fig. 2.—Turpentine boxes endangered by ground fires.....	20
VI. Fig. 1.—Cutting flat faces for gutters on untapped timber. Fig. 2.—Making cut for insertion of gutter.....	20
VII. Fig. 1.—Inserting gutters. Fig. 2.—Cup and gutters in position (face ready for chipping).....	24
VIII. Fig. 1.—Making cuts and inserting gutters on second-year boxed trees. Fig. 2.—Making cut for gutter on high face.....	24
IX. Extra cups required on very productive tree.....	32
X. Fig. 1.—Waste of resin on under-face, due to shallow insertion of gutters at center of face. Fig. 2.—Clean under-face, resulting from deep insertion of gutters at center of face.....	32
XI. Fig. 1.—Chipping first-year cupped tree. Fig. 2.—Chipping second-year face (tree boxed one season).....	36
XII. Fig. 1.—“Pulling” (chipping) fourth-year face (tree boxed three seasons). Fig. 2.—Dipping fourth-year cups.....	36
XIII. Removing gutters from fourth-year faces.....	40
XIV. Drawing nails from fourth-year faces (old box burned out by ground fires).....	40
XV. “Scrape-box” for gathering scrape from unboxed trees.....	40

TEXT FIGURES.

FIG. 1. Plat of an experimental turpentine forest in Georgia, showing the distribution of cupped and boxed trees in comparative tests made on a first-year (“virgin”) crop.....	21
2. Diagram showing mean weekly temperature, humidity, prevailing winds, and weekly rainfall for chipping season of 1902, Ocilla, Ga....	22
3. Diagram showing the number of trees in boxed and cupped halves of first-year crop, grouped according to diameters.....	25
4. Diagram showing the average number of faces per tree in boxed and cupped halves of first-year crop.....	27
5. Device for shaping gutters.....	35

A NEW METHOD OF TURPENTINE ORCHARDING.

CRITICAL CONDITION OF THE NAVAL-STORES INDUSTRY.

The products of the naval-stores industry are tar, pitch, spirits of turpentine, and rosin. The latter two are obtained by distillation from crude turpentine, a resin obtained in the United States chiefly from the Longleaf Pine. For a number of years the seat of this industry was the forests of eastern North Carolina. A little later it was transferred to South Carolina. Within recent years the increased demand for spirits of turpentine and rosin in the arts and manufactures has led to an enormous growth of the industry, which centers at present in Florida, and is making marked inroads into Alabama, Mississippi, and Louisiana.

Formerly an unbroken forest of Longleaf Pine extended from southern Virginia through the South Atlantic and the Gulf States to eastern Texas. The advance of the naval-stores industry into this region has been due to the depletion of the forest under its attack. More than one-half of the original forest has been exhausted, with no renewal. Conservative operators now estimate a standing supply of virgin timber sufficient only for fifteen years of box cutting.

Until recently the destructive methods in use have been regarded with entire indifference in the regions affected. This has been due to the low valuation of timber throughout the turpentine belt, and to the popular belief that the pine forests of the Southern States were inexhaustible. But it has now become evident that if the naval-stores industry is to be perpetuated some method must be found which will not be prohibitive of later operations in the same field.

In consequence of the rapidly diminishing supply of virgin timber and the overproduction of naval stores during the past few years, there was organized in 1901 the Turpentine Operators' Association, whose primary object is, by joint agreement of its members, to restrict the output within reasonable bounds. This, however, can at best only postpone the evil day unless some radical reform in operating methods is introduced.

THE PRESENT METHOD OF TURPENTINE ORCHARDING.

Turpentine gathering, as now conducted in the United States, is needlessly destructive of the forests and needlessly wasteful of the product. The method, under the box system now universally employed,

is to chop in the base of the tree itself a cup-like cavity, the sole purpose of which is to receive the resin which flows from a scarified face of the trunk above it. The box itself does not add to the flow of turpentine; on the contrary, experiment has proved that it diminishes the flow. It is an unnecessary wound driven into the body of the tree at its most vital spot, both weakening its vigor and lessening its power to support the strain of the wind. At the same time it opens the trunk to disease and provides a storehouse of combustibles against the coming of the forest's great enemy—fire. A forest which has been heavily turpented by this method has before it only decay and death.

To make clear in detail the evils of the box system and the exact modification of the present methods proposed in order to carry into effect the plan advocated in this bulletin, it is necessary to describe in full the process by which turpentine is now gathered.

THE BOX SYSTEM.

BOX CUTTING.

This is the first step in turpentine operating, and employs the turpentine labor during the winter. The box is a cavity 14 inches wide, 7 inches deep, and $3\frac{1}{2}$ inches from front to back, cut into the base of the tree by means of a long, narrow ax. (Pl. I, fig. 1.) This box has no other function than that of a receptacle for resin. Two, three, and sometimes four boxes are cut in the larger trees. In the small trees the box is necessarily smaller, although larger relatively to the size of the tree.

CORNERING.

Box cutting is followed by cornering. This is done with an ordinary ax, a right-handed and a left-handed man working together. A slanting cut is made through the bark and about 1 inch into the sapwood, the cut rising slightly from the top of the back of the box to a point perpendicularly above the corner of the box. By a side blow with the ax the wood is then split out between the cut and the rounding edge of the back of the box. (Pl. I, fig. 2.) The object of cornering is to provide a suitable surface for the subsequent scarification of the tree, and to direct the resin into the box.

CHIPPING.

In early spring the "chipping," or scarification of the trees, begins. It is continued weekly until November, and serves to open fresh resin ducts. (Pl. II, fig. 1.) The work is done by means of a "hack," a tool consisting of a flat steel blade in the form of the letter U. This blade, sharpened along its under edge, is fastened by means of a shank, at a right angle, into a wooden handle $1\frac{1}{2}$ feet in length, on the

end of which, to give greater momentum to the stroke of the "hack," is set an iron weight of from 5 to 7 pounds. The "chipper," standing squarely in front of the box, removes with the "hack" a strip of bark and sapwood three-fourths of an inch wide just above the exposed surface produced by cornering, the laterally-inclined strokes being made from the right and from the left sides and penetrating the sapwood about 1 inch at the deepest point. The freshly exposed surfaces of sapwood, called the "streak," meet just above the center of the box. The angular point thus formed is known as the "peak." The distance of the "streak" from the box increases with each weekly chipping. When the distance from the box is too great to admit of easy reach with the "hack," another tool, the "puller," is substituted, the result being the same in each case. (Pl. XII, fig. 1.) Thirty-two streaks or chippings constitute a full season's work for the chipper.

DIPPING.

Immediately after chipping the fresh resin appears and flows slowly into the box below. The flow is most rapid during the first two days after chipping; it then grows gradually less until after six or seven days no further flow takes place on most of the trees. At intervals of three or four weeks the resin in the boxes, called "dip," is transferred to large buckets by means of a flat metal instrument set on a long handle, and called a "dipper," or "dip" spoon. (Pl. II, fig. 2.) From the buckets the dip is emptied into barrels placed at suitable intervals. The filled barrels are then hauled to the distillery, or "still."

SCRAPING.

At the close of the chipping season the resin which has hardened on the exposed "face" of the tree, called "scrape," is removed by a sharpened flat tool and collected in barrels for distillation. This scrape contains approximately one-half as much spirits of turpentine as the dip from the boxes.

RAKING.

After the trees have been scraped, each is "raked." This is a measure of protection against the annual burning of the grass, fallen pine needles, and undergrowth, which commonly occurs throughout these forests. It is done by clearing of everything combustible a space of at least 3 feet around each tree, the tool used being, not a rake, but a broad hoe. This annual raking is a considerable item of expense to the operator; in spite of it, boxes are frequently burned out by the ground fires. (Pl. V, fig. 2; Pl. XIV.)

THE CROP.

The working unit in turpentine operating is the "crop," a tract of timber extending usually over an area of from 200 to 250 acres, and

containing from 8,000 to 10,500 boxes, the number of boxes averaging two to the tree throughout the crop. The chipping of a crop constitutes the weekly task of one chipper. Usually the supervision of the work on from ten to fifteen crops is intrusted to one "woodsman."

DRIFTS.

For convenience the area of the crop is subdivided into "drifts," the limits of which are marked by lines blazed on the trees. The number of boxes in each drift varies between wide limits, though formerly 2,100 boxes constituted a drift.

DISTILLATION.

One 25-barrel still suffices for the distillation of the products collected from twenty-five crops. The dip or scrape is placed in large copper stills, heated by direct flame from below. During distillation a stream of water flows into the still, from which the volatile spirits of turpentine are carried over, mixed with steam, into a large copper worm, where they are condensed. The nonvolatile rosin (colophony) remaining in the still is drawn from a tap at its lower edge into strainers, which remove chips, bark, sand, etc., the clear rosin passing into a vat below, from which it is dipped into barrels to cool and solidify. The rosin from first-year (virgin) dip is pale yellow, that from the later years of working is much darker. Pale rosins bring a much higher price than the darker or common rosins.

CHIEF EVIL OF THE BOX SYSTEM.

A superficial inspection of active turpentine operating, or the territory through which the naval-stores industry has passed, suffices to show that the great weakness in the present system is the box. This weakness appears in two directions.

First, in the collection of crude turpentine:

(a) The box lessens the power of the tree to produce resin by the injury to its vitality, and results in an important loss to the operator in the quantity of resin obtained.

(b) The box which receives the resin is at a fixed point, while the streak, where the fresh resin exudes from the tree, is constantly receding from the box as a result of the weekly chipping. Thus an ever-increasing space is produced, along which the resin must flow in order to reach the box. Consequently, as the work proceeds from year to year, a greater surface for evaporation of the spirits of turpentine is offered, and more and more of the resin sticks to the face of the tree, giving a comparatively smaller quantity of dip. (Pl. III, fig. 1.)

(c) The action of the atmosphere on the resin remaining on the exposed face changes the fresh wood into so-called lightwood, or fat pine. In the following year the resin, flowing over this lightwood face, absorbs much coloring matter. This, together with the increased



FIG. 1.—CUTTING A BOX.



FIG. 2.—CORNERING A BOX.

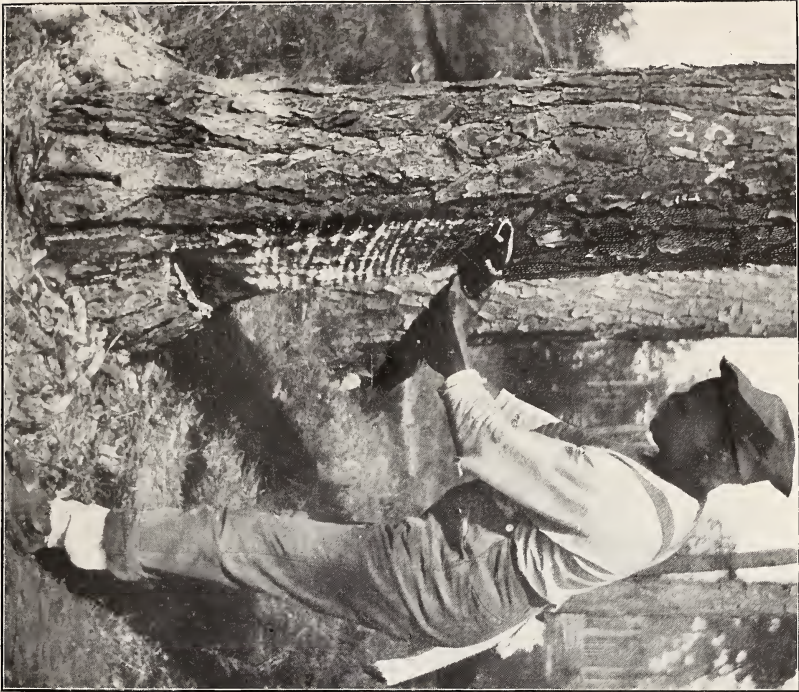


FIG. 1.—“CHIPPING.”



FIG. 2.—DIPPING CRUDE TURPENTINE FROM A BOX.

action of light and air, produces a deterioration in the quality of the resin, which gives on distillation dark-colored rosins.

(*d*) Very few pines stand perpendicularly. As the work of scarification proceeds higher up the tree, the perpendicular from the peak often falls outside the box. Consequently, in the later years much of the resin drops outside the limits of the box and wastes. (Pl. III, fig. 2.)

Second, injury to the timber:

(*a*) In boxing, the smaller trees are often cut at least two-thirds across. Many of these trees are blown down by wind. (Pl. IV.) So also when two boxes are placed in medium-sized trees the strip of wood left is often too narrow to support them. Much worse is the case of "back-boxed" timber, or timber which it is sought to work a second time by cutting fresh boxes between the old ones wherever space can be found. The slightest storm is sufficient to level such a tract. (Pl. V, fig. 1.)

(*b*) But the greatest injury to timber from boxing is indirect, and its effect is felt only after turpentine operating is ended. So long as the turpentine operator has charge of the timber, he protects the trees from fire each winter by raking. When the woods are burned in February, a few of the boxes which have been imperfectly raked catch fire; but this is the exception. But when the operator leaves, the timber owner, having no longer a direct revenue from the timber, does not take the precaution of raking the timber each year. Consequently, fire easily catches in the old resin which collects in the boxes. (Pl. V, fig. 2.) To make matters worse, the heat of the burning resin in the box draws out the resin from the old face above, which, catching fire and melting, flows down into the box and increases the fire. Even if the tree is not destroyed, much of the fresh growth of new wood around the box is burned, thus retarding the recovery of the pine.

(*c*) The constant presence of water in the old box frequently produces rotting at the base of the tree, so that many pieces of timber cut from old boxed trees must be butted at the sawmill.

(*d*) Dr. A. D. Hopkins, of the Division of Entomology, U. S. Department of Agriculture, who has charge of the investigations of injurious forest insects, in cooperation with the Bureau of Forestry, informs the writer that, in general, any injury which serves to weaken the vitality of pine trees renders them specially attractive to certain bark and wood boring beetles and grubs, and that the severe injury to the Longleaf Pine which often results from boxing, together with the subsequent injuries by forest fires, offers most favorable conditions for the work of destructive insects. These not only kill such trees, but breed in them in such numbers that when the broods of adults emerge, they attack and kill near-by uninjured trees.^a

^aSee Bull. 21, n. s., Division of Entomology, U. S. Dept. of Agriculture, pp. 23, 24.

NECESSARY REQUIREMENTS IN AN IMPROVED SYSTEM.

In view of the many objections to the box, harmful alike to the operator and the timber owner, it has long been evident that the substitution of some system of collecting crude turpentine free from the evils above mentioned would constitute an important step toward the perpetuation of the naval-stores industry.

In order that such a system be practical and effective, the following requirements must be met:

First.—An immediate increased profit should be assured to the turpentine operator, who has no direct interest in the timber, but leases the turpentine privilege from the owner, for a period usually of three years. For this reason, and that no very great outlay of extra capital be required at the beginning, the equipment must be inexpensive.

Second.—In the interests both of the timber owner and of the operator, who wishes to secure a maximum yield of resin, the placing of the equipment should injure the tree as little as possible.

Third.—No change should be necessitated in the subsequent labor of chipping. In this labor the negroes in the turpentine belt are especially skillful. Any change in this respect would present grave labor difficulties, which would doubtless at the present prove fatal to a new system.

Fourth.—The placing of the equipment should require no especial skill other than that possessed by the regular turpentine laborer. This for two reasons: In the first place, that such skilled labor would be rarely available, and in the second place, that the loss of the winter work would result in great hardships to the laborers now engaged in box cutting.

Fifth.—The construction of the equipment should be as simple as possible, and free from hinges or joints, which would soon lose their efficacy from the effect of the rapidly hardening resin.

Sixth.—In turpentine operating, trees of all sizes, from 6 inches in diameter to the largest, are utilized. The equipment should therefore be capable of being readily fitted to all trees.

Seventh.—The equipment must hold so firmly in place that it can not be accidentally dislodged, and at the same time must be such that it can be readily and cheaply removed at the end of each season and raised to a new location near the chipping surface, to avoid, during the following season, the evaporation of spirits of turpentine and discoloration of the resin resulting, in the box system, from flow over the lengthened face.

Eighth.—To prevent loss in transferring the resin to buckets, the receptacle should be capable of being removed from the tree and emptied immediately over the bucket. At the same time it should be so secured to the tree that it can not easily be displaced by cattle grazing in the woods.

Ninth.—The receptacle should be effective in preventing the loss of resin from a fresh chipping when filled with rain water, the resin being lighter than water when it first reaches the receptacle, but viscid and slowly increasing in specific gravity.

EARLIER SUBSTITUTES FOR THE BOX SYSTEM IN THE UNITED STATES.

The evident wastefulness of the box system has led to numerous attempts to devise some more economical method.

In 1869 Mr. A. Pudigon invented a substitute for the box which received a commercial test of its practicability at Monks Corner, S. C. No record of the reason for the abandonment of the test has been found. Mr. J. C. Schuler has on two occasions patented a substitute for the box, and in 1895 worked 60,000 cups at West Lake, La., on the place of Lock, Moore & Co. This work was abandoned on account of the expense incident to placing the cups on the trees. Mr. Schuler announces, however, that by the use of improved tools this difficulty can now be overcome. Still other substitutes for the box have been devised by Messrs. Johnson, Steele, Hazard, Hamilton, Clements, Ivey, Cooper, Ketchum, Smith, Soger, and Vickers. None of these devices has as yet proved of lasting value to the naval-stores industry.

The interest of the U. S. Department of Agriculture in the conservation of the timber resources of the country led to an exhaustive study of the Longleaf Pine forests, by Dr. Charles Mohr, agent of the Division of Forestry.^a In the Report of the Chief of the Division of Forestry, 1902, a comprehensive account was given of the naval-stores industry, not only in America, but also in European countries, and various suggestions were made for the improvement of the industry in the Southern States. These publications failed to reach the mass of the turpentine operators, and no reforms were effected.

TURPENTINE GATHERING IN FRANCE.

In marked contrast with American methods are those employed in the pineries of southern France.

The small output of naval stores from the Southern States during the civil war and the years just following produced very high prices for all such products. This led the French to introduce more conservative and economical methods of operation, the Hugues system, employing a clay cup and a zinc gutter, replacing the more wasteful method of collecting the resin in a hole dug in the sand at the base of the tree. In this system the scarification of the tree is effected by means of an axe with a curved face, the depth of the cut being one-third of an inch, and its width $3\frac{1}{2}$ inches. From this cut the resin

^aBull. No. 13, The Timber Pines of the Southern States.

flows over the gutter into the clay cup, which rests upon a nail. Under this system the trees are worked for from thirty to forty years.

For the financial success of such a system trained foresters and cheap labor are necessary. Neither of these requirements is present in the Southern States. Again, the introduction of such a system would necessitate a complete change in labor, the negroes being skilled in the use of a tool very different from the French ax used in scarifying.

The application of the French gutter, designed for a flat surface of a uniform width, is also impracticable, for in the American system of chipping two strokes are used, from the right and from the left sides, producing two exposed surfaces meeting at an angle, the width of the face and the sharpness of the angle varying of necessity with the size of the tree.

HISTORY OF THE PRESENT INVESTIGATION.

During the spring of 1901 the writer began a careful study of conditions in the Georgia forests of Longleaf Pine, visiting various points in the turpentine belt and conducting an extensive correspondence with those interested.

It was soon apparent that the destructive influence of the naval-stores industry had already been felt in every portion of the State in which the Longleaf Pine occurred. On every hand reports were heard of substitutes for the box, many of which had been tested on a commercial scale, but none found of lasting value. Throughout the industry the uniform practice of boxing the trees was found, necessitating a move farther south or west, into virgin timber, as soon as the territory had once been worked over.

PRELIMINARY EXPERIMENTS.

With the French system in mind as a point of departure, the system of cups and gutters described below was devised by the writer. After repeated efforts some interest was aroused, and a guaranty fund of \$150 was raised among the naval-stores factors to defray the actual field expenses of experimental work with this equipment during the summer, the writer to receive no remuneration. A tract of timber suitable for the experiment was provided at Statesboro, Ga.

On learning of the proposed experimental work, the Bureau of Forestry of the U. S. Department of Agriculture tendered the writer an appointment as collaborator, in order to assist the investigation.

The effort to secure earthen cups failed, as the potteries were unwilling to undertake the filling of so small an order of a special design; consequently galvanized-iron cups were used. With the apparatus at hand, work was begun, to the great amusement of the local inhabitants, especially the negroes, to whom the sight of the cups on the trees was



FIG. 1.—FORMATION OF "SCRAPE" ON A HIGH FACE.

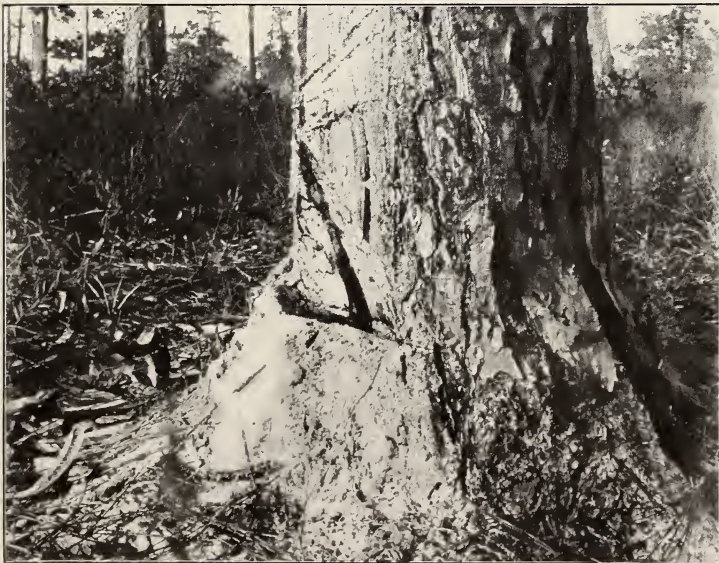


FIG. 2.—WASTING RESIN FROM A LEANING TREE.



BOXED SAPLING PINE BLOWN DOWN AT BEGINNING OF SEASON.

at once novel and ludicrous. Comparative studies were made of first, second, third, and fourth year boxes in sets of 100 each. 50 cups and 50 boxes, as to the quantity and quality of the resin collected under the two systems, the effect of temperature and rain on the flow of resin, and other points. The result of the summer's work brought to light many interesting facts, and satisfied the writer that the apparatus could be used successfully on a commercial scale. But the summer vacation was ended, and a return to university duties was obligatory.

The interest of the Bureau of Forestry in the results of this experiment, and its confidence in the future of the work, led the writer to accept a commission, as an officer of the Bureau, to conduct systematic investigations in this field, and on February 1, 1902, the experiments at Ocilla, Ga., were begun.

CUP-AND-GUTTER SYSTEM IN OPERATION.

The method of operation of the cup-and-gutter system is as follows: An earthen cup, having at the top a stout rim, and in this rim a half-inch hole, is suspended from a nail driven into the tree. To lead the resin to this cup two strips of thin galvanized iron are used. (Pl. VII, fig. 2.) These strips are each 2 inches wide and in length from 6 to 12 inches, and are bent along the center lengthwise at an angle of about 120 degrees.

In placing the equipment on unboxed timber, two flat faces are provided by means of cornering axes, a right-handed and a left-handed man working together. (Pl. VI, fig. 1.) The first strokes with the ax are the same as in cornering. This provides the proper surface for the subsequent process of chipping. Next, by side strokes of the ax, the bark and a portion of the sapwood are removed, sufficient to provide a flat face one-half the width of the full face. As a result of the work of the two men, a double face is provided, corresponding in width to that of the box which would have been placed in such a tree.

This work is followed by that of right-handed and left-handed workmen using broadaxes. These broadaxes have a straight edge 12 inches long. The stroke of the broadax is made with the head of the ax turned slightly down, in order to give proper inclination to the gutter. (Pl. VI, fig. 2.) With one blow of the ax an inclined incision is made across the flat face about one-fourth of an inch deep, going slightly deeper at the center of the face than at the edge, and placed about 3 inches below the chipping surface. Space is thus given for the passage of the hack in chipping. The cut on the opposite side is made about 1 inch lower than the first cut. Into these incisions the strips of galvanized iron are firmly inserted, either by being placed directly in the cut and pressed toward the center of the tree, or better (Pl. VII, fig. 1), by being slipped into the upper end of the cut and shoved down its full length. The upper gutter is brought just to the center of the face.

The lower gutter passes beyond the center about $1\frac{1}{2}$ inches, forming a spout which conveys the resin from both gutters to the cup below.

In hanging the cup care is taken to drive the nail (a common 6-penny wire nail) at a sharp downward incline and deep enough to leave only about three-fourths of an inch exposed. The nail is driven on the same side of the tree with the upper gutter, so that the cup when hung shall not be more than half an inch below the end of the spout of the lower gutter, and the nail shall be as far as possible from the dripping resin.

In subsequent years, or in case the equipment be placed on trees which have previously been worked under the box system, it is unnecessary to provide the flat face with the cornering ax, as the surface left by the chipping of the previous season answers the same purpose. (Pl. VIII, fig. 1.) On the higher faces, however, the workmen with the broadaxes change sides, the blow with the broadax being in the latter case an over-hand stroke. (Pl. VIII, fig. 2.)

SCOPE OF THE TEST.

A thorough and extended test of the practical working of the new system was made at Ocilla, Ga., throughout the season of 1902. An arrangement was made by the Bureau of Forestry with the firm of Powell, Bullard & Co., of that place, by which the Bureau furnished the equipment and placed it on the trees without expense to the firm, the latter in turn doing the regular work of chipping, dipping, scraping, and stilling, keeping the records from the experimental crops separate, receiving any profits that might result from the work, and furnishing the results to the Bureau for publication.

Only comparative results were sought. The important question was the relative yield of the same timber under the cup and the box systems, and the market value of the products of each.

A first, a second, a third, and a fourth year crop were selected by Mr. J. H. Powell, the manager of the company, and one-half of each crop was worked by the box system, the other half by the cup system. This being the first year of experimental work, it was necessary in the second ("yearling"), third, and fourth year crops to make use of timber which had been boxed in previous years.

As far as practicable the chipping in each crop of both cup and box faces was done by one "chipper." Throughout the entire season, and in every phase of the work, only the regular turpentine labor of Messrs. Powell, Bullard & Co. was employed.

When this work was first projected many experienced turpentine operators insisted that it was impracticable, on account of the negro labor exclusively used throughout the turpentine belt, which it was thought could not be taught to work in any but the orthodox way.

Events, however, proved the contrary. At the outset, it is true, great difficulty was experienced in securing a squad of hands. All of the regular labor was engaged at the time in box cutting, and there was besides a general dislike of the new method among the negroes, none having any confidence in the future of the work, and all considering it rather beneath the dignity of good turpentine labor. Moreover, the uniform wage rate was \$1 per day—small wages for good hands in the box-cutting season. In spite of these difficulties a small squad was organized to which additions were made as the work demanded. It is a pleasure to record the fact that good, steady work was done by the squad, the negroes soon becoming interested. While placing the gutters in the second-year crop the entire squad kept steadily at work in a driving February rain without extra pay, not only attesting their interest but demonstrating the fact that the work can be carried on regardless of weather conditions.

As experience is gained with the introduction of the system on a larger scale, improvements will doubtless be made in the organization of the work in the woods, and it may prove wise to fix different wages for different kinds of work; but after the experience of the past season any operator may feel assured that his present labor is abundantly capable of carrying on work by the cup system.

In each of the four crops the crude turpentine was collected separately from the cups and from the boxes. The barrels of dip were labeled in the woods, and a record of them furnished by the wagoner to the "woodsman" in charge of the crop. At the still the "dip" from each half was distilled separately, the spirits of turpentine being accurately measured from each charge, both dipping pot and gauge rod being used for this purpose, while the rosin was dipped into barrels and marked to indicate the half crop from which it came. From time to time the rosin was shipped in carload lots to the Southern Naval Stores Company of Savannah, who courteously furnished separate sales sheets, with gradings of the rosin from each half crop. In the same manner at the close of the season the "scrape" was collected separately from the eight half crops, distilled separately, and the rosin sold under special designation as "scrape rosin" from the individual half crops. It was thus possible at the end of the season to strike a balance showing the relative merits of the two systems. The results are shown in the three tables on the following page.

RESULTS.

TABLE 1.—Season's record of spirits of turpentine from eight half crops.

Half crop.	From dip.	From scrape.	Total	Excess from cupped trees.	Per cent of excess from cupped trees.
	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	
First year:					
Cups.....	1,385.3	205	1,590.3	301.9	23.43
Boxes.....	1,134.7	153.7	1,288.4		
Second year:					
Cups.....	1,087.2	188.2	1,275.4	66.6	5.51
Boxes.....	941.8	267	1,208.8		
Third year:					
Cups.....	726.5	113	839.5	310.1	58.58
Boxes.....	851.9	147.5	999.4		
Fourth year:					
Cups.....	687.2	101	788.2	314.2	66.29
Boxes.....	849.5	124.5	974		

TABLE 2.—Season's record of net rosin sales.

Half crop.	From dip.	From scrape.	Total.	Excess net sales.	Per cent excess net sales, cupped trees.
First year:					
Cups.....	\$401.72	\$47.72	\$449.44	\$85.51	23.50
Boxes.....	328.40	85.53	363.93		
Second year:					
Cups.....	266.34	49.25	315.59	144.13	84.64
Boxes.....	104.51	66.95	171.46		
Third year:					
Cups.....	171.27	27.44	198.71	132.65	90.90
Boxes.....	39.49	26.57	66.06		
Fourth year:					
Cups.....	167.33	29.23	196.56	132.56	207.13
Boxes.....	36.09	27.91	64.00		

TABLE 3.—Summary of net sales of spirits of turpentine and rosin for season.

Half crop.	Spirits of turpentine.	Net value of spirits at 40 cents per gallon.	Net sales of rosin.	Total value of spirits and rosin from half crops.	Net excess values from cupped half crops.	Net excess values from cups on a basis of one crop.
	<i>Gallons.</i>					
First year:						
Cups.....	1,590.3	\$636.12	\$449.44	\$1,085.56	\$206.27	\$412.54
Boxes.....	1,288.4	515.36	363.93	\$79.29		
Second year:						
Cups.....	1,275.4	510.16	315.59	\$25.75	170.77	\$41.54
Boxes.....	1,208.8	483.52	171.46	\$54.98		
Third year:						
Cups.....	839.5	335.80	198.71	\$34.51	250.69	\$13.38
Boxes.....	999.4	211.76	66.06	277.82		
Fourth year:						
Cups.....	788.2	315.28	196.56	\$11.84	258.24	\$16.48
Boxes.....	974	189.60	64.00	232.60		

NOTE.—The arbitrary price of 40 cents per gallon for spirits of turpentine represents an average net price at Odessa during the past season, based on the daily market quotations.



FIG. 1.—EFFECT OF SLIGHT STORM ON "BACK-BOXED" TIMBER.



FIG. 2.—TURPENTINE BOXES ENDANGERED BY GROUND FIRES.



FIG. 1.—CUTTING FLAT FACES FOR GUTTERS ON UNTAPPED TIMBER.



FIG. 2.—MAKING CUT FOR INSERTION OF GUTTER.

FIRST-YEAR CROP ("VIRGIN").

The tract for the first-year crop was carefully selected by Mr. Powell, to secure timber of average quality for the region, and the two half crops were marked off in such a way as to make an equable division of the timber between the cups and the boxes. But to eliminate any chance of unequal division of the timber, and to avoid the effect of differences of temperature, rain, etc., between the beginning and the end of the weekly chipping, the "drifts" of cups and boxes were alternated, as shown in fig. 1.



FIG. 1.—Plat of an experimental turpentine forest in Georgia, showing the distribution of cupped and boxed trees in comparative tests made on a first year ("virgin") crop.

On account of delay in the receipt of the cups, the box cutting in the boxed half of the crop was begun in advance of placing the cups. Two drifts of boxes were cut during the first week of March. As the number of boxes in the two drifts cut did not reach the requisite number, 5,250, the drift line in the first box drift was extended into the drift originally set aside for a cup drift, and the requisite number of boxes cut. Consequently, it was necessary to make use of a portion of a third drift in placing the cups, this small cup drift being designated on the chart, "1st cup drift." The boxes were cornered during the week beginning March 10.

The placing of the cups began on March 8, and was finished at noon

on March 14. Chipping began on March 24. It was originally intended to have the entire crop chipped by one chipper, but on account of the small number of boxes in an adjoining crop the first cup drift was given to another chipper. No double chipping—that is, chipping the trees twice in one week—was practiced in this crop. Only regular work was insisted upon, and this for the full season of thirty-two weeks.

With the exception of the last dipping, which included the last five weeks of the season, the boxes and cups were dipped every three weeks. In dipping this crop four laborers were used, two in the boxed and two in the cupped drifts.

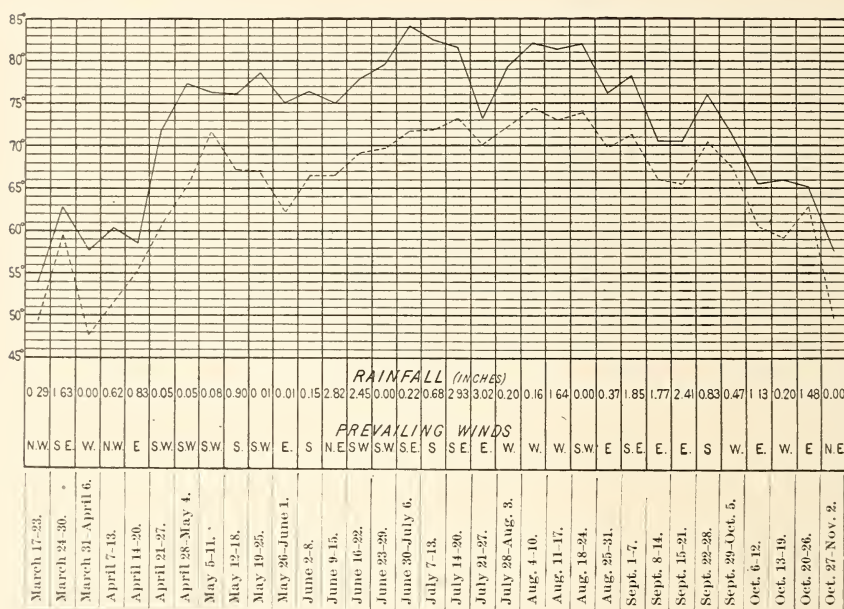


FIG. 2.—Diagram showing mean weekly temperature, humidity, prevailing winds, and weekly rainfall for chipping season of 1902, Ocilla, Ga.

On account of the prevailing cold weather of March, the boxes and cups were not dipped before the chipping began. On inspection it was evident that more resin had been obtained from the box cutting and cornering than from the placing of the cups, but no exact figures can be given on this point. Nevertheless a considerable quantity was found in the cups. Theoretically, there should result from the placing of the cups about the same amount of resin as is obtained from cornering.

In order to compare the flow of resin with variations in temperature, winds, and rainfall, daily records were kept, the mean weekly records being given in fig. 2.

A summary of these observations for thirty-three weeks, March 17 to November 2, shows—

Mean temperature.....	degrees..	72.8
Mean humidity.....	do.....	65.5
Total rainfall.....	inches..	29.25

TABLE 4.—*First-year crop—Dippings.*

Number of dipping.	Date of dipping.	Number of chip-pings.	Barrels of dip obtained.		Spirits of turpentine on distillation (gallons).		Excess spirits of turpentine (gallons).	
			Boxes.	Cups.	Boxes.	Cups.	Boxes.	Cups.
1.....	Apr. 14	3	a 9½	b 7½	101.6	84.3	17.3	.....
2.....	May 5	3	9½	10½	111.0	130.5	.....	19.5
3.....	May 26	3	12	14½	136.8	178.3	.....	41.5
4.....	June 16	3	12½	17½	143.3	191.2	.....	47.9
5.....	July 7	3	12½	14½	142.4	175.2	.....	32.8
6.....	July 28	3	10½	12½	115.2	141.7	.....	26.5
7.....	Aug. 18	3	10	11½	106.6	126.6	.....	20.0
8.....	Sept. 8	3	8	10½	86.1	105.9	.....	19.8
9.....	Sept. 29	3	7½	9½	80.8	106.0	.....	25.2
10.....	Nov. 4	5	c 10½	12½	110.9	145.6	.....	34.7
Total.....		32	101½	121½	1,134.7	1,385.3	17.3	267.9

a Including resin from box cutting and cornering.

b Including resin from placing cups on trees.

c Boxes dipped after trees have been scraped.

TABLE 5.—*First-year crop—Scraping.*

Half crop.	Date.	Net weight of scrape.	Spirits of turpentine on distillation.	Excess spirits of turpentine from cupped trees.
		Pounds.	Gallons.	Gallons.
Cupped trees.....	Nov. 5	13,155	205	51.3
Boxed trees.....	do...	10,315	153.7	.....

TABLE 6.—*First-year crop—Net sales of rosin.*

Half crop.	Rosin from dip.	Rosin from scrape.	Total net sales.	Excess net sales from cups.
Cups.....	\$401.72	\$47.72	\$449.44	\$85.51
Boxes.....	328.40	35.53	363.93	.....

TABLE 7.—*First-year crop—Summary of spirits of turpentine and rosin.*

Half crop.	Spirits of turpentine.	Net value at 40 cents per gallon.	Rosin, net sales.	Total net value of spirits of turpentine and rosin.	Excess net values from cups.
	Gallons.				
Cups.....	1,590.3	\$636.12	\$449.44	\$1,085.56	\$206.27
Boxes.....	1,288.4	515.36	363.93	879.29	.....

Table 7 shows that 1,288.4 gallons (25 barrels) of spirits of turpentine were obtained from the half crop of boxes. This confirms the judgment of Mr. Powell concerning the quality of the timber in this crop, the average yield from a crop of first year ("virgin") boxes on his farm being 50 barrels of spirits of turpentine. The same table shows a yield of 1,590.3 gallons (32 barrels) from the half crop of cups, representing thus a yield of 62 barrels of spirits of turpentine per crop from such average timber.

REASONS FOR EXCESS YIELD FROM CUPPED TREES.

The increase of $23\frac{1}{2}$ per cent in the output from the cupped half of the first-year crop is to be attributed principally to the increased vitality of trees which have not been wounded by boxing. Added to this are a less wasteful method of dipping the cups, the placing of extra cups on the very productive trees, which fill the first cup before the time for dipping, and the smaller percentage of unproductive surface developed on cupped trees.

None of the disadvantages of boxing previously discussed apply in the case of first-year trees. The receptacle in each case is equidistant from the streak. Consequently in each half there is the same loss of spirits of turpentine by evaporation. The discoloration of the rosin, resulting from the flow of the resin, is the same in each half. Because of the slight slant of many of the trees there is no waste of resin in the first year. Fire has not passed through the woods since the work began. The number of blown-down and dead trees in the two halves shows some variation, but the difference during the past season was not material; for by actual count there were found:

TABLE 8.—*Record of down and of dead trees.*

	Trees blown down.		Trees dead.	
	In boxes.	In cups.	In boxes.	In cups.
After sixteen chippings	5	1	2	1
After thirty-two chippings	8	3	35	16

To supplement the judgment of Mr. Powell and the woodsmen as to the equality of the division of the timber careful count was made, after sixteen chippings, of the box faces and the cup faces in each half of the crop, and the diameter of every tree was measured by calipers. Note was also made as to whether the tree was Longleaf Pine ("Hill Pine") or Cuban Pine (distinguishing in this latter class "slash" and "old field slash"). The width of each face was measured, and the



FIG. 1.—INSERTING GUTTERS.



FIG. 2.—CUP AND GUTTERS IN POSITION (FACE READY FOR CHIPPING).



FIG. 1.—MAKING CUTS AND INSERTING GUTTERS ON SECOND-YEAR BOXED TREES.



FIG. 2.—MAKING CUT FOR GUTTER ON HIGH FACE.

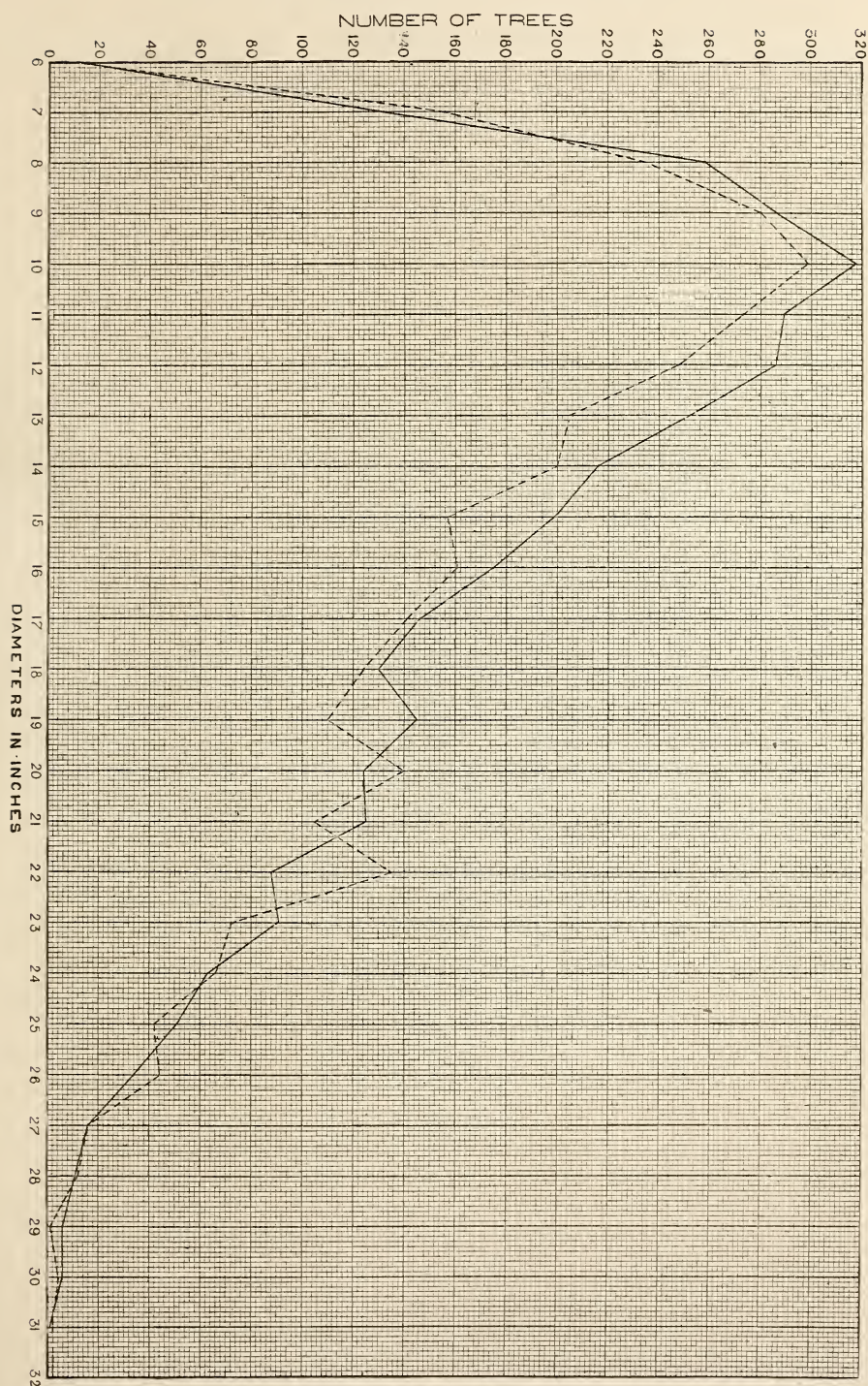


FIG. 8.—Diagram showing the number of trees in boxed and cupped halves of first-year crop, grouped according to diameters. ——— Boxed trees. - - - - Cupped trees.

number of faces on each tree was recorded. As a result there was found:

TABLE 9.—*Record of division of trees.*

Half crop.	Number of trees.	Number of faces.	Average face per tree.	Average diameter of trees.	Average width of face.	Hill Pine faces.	Slash Pine faces.	Old field slash faces.
				<i>Inches.</i>	<i>Inches.</i>			
Cups.....	3,243	5,217	1.61	14.68	12.29	4,313	798	106
Boxes.....	3,462	5,242	1.51	14.55	12.50	4,061	1,146	35

The excess of "old field slash" faces—71 in the cupped half—is more than offset by the still greater excess of "Slash Pine" faces—348 in the boxed half—both of these forms being characteristically very productive.

The average diameter of the trees in the cupped half is 0.13 inch greater than in the boxed half; but the measurements show that the average width of face in the cupped half is 0.21 inch less than in the boxed half. Finally, while the table shows 219 more trees in the boxed half, it also shows that the average number of faces per tree in the cupped half is only 0.10 greater than in the boxed half. The significance of these facts is shown in figs. 3 and 4, in which the trees are divided into groups according to diameter, trees from 6 to 6.9 inches in diameter being termed 6-inch trees, from 7 to 7.9 inches, 7-inch trees, etc. • While there is a slightly greater number of small trees in the boxed half, the larger trees in the cupped half have a greater number of faces per tree than do the trees with corresponding diameters in the boxed half, the larger cupped trees thus being taxed more severely by chipping than the boxed trees.

In dipping the boxes there is frequently a loss of resin in transferring it from the box to the bucket. In dipping the cups no loss of this kind occurs, for the cup is lifted from the nail and held directly above the bucket while the resin is removed.

A few trees throughout the crop produce an exceptional quantity of resin. Under the box system, if such a tree produces sufficient resin to fill the box in two streaks, its efficiency during the third week is lost, for either the chipper does not chip it, or, the box being already full, the resulting resin overflows and is wasted on the ground. Under the cup system, as soon as such a tree is noted an extra cup is hung on one side of the face, and the chipper changes these cups on the third streak. This he does willingly, if he is required to chip the tree every week, rather than be compelled to stand in a puddle of resin in making subsequent chippings. (Pl. IX.)

Any tract of turpented timber will show, even to the most casual observer, that portions of many faces become unproductive. Where formerly resin exuded from the entire surface of the streak, a con-

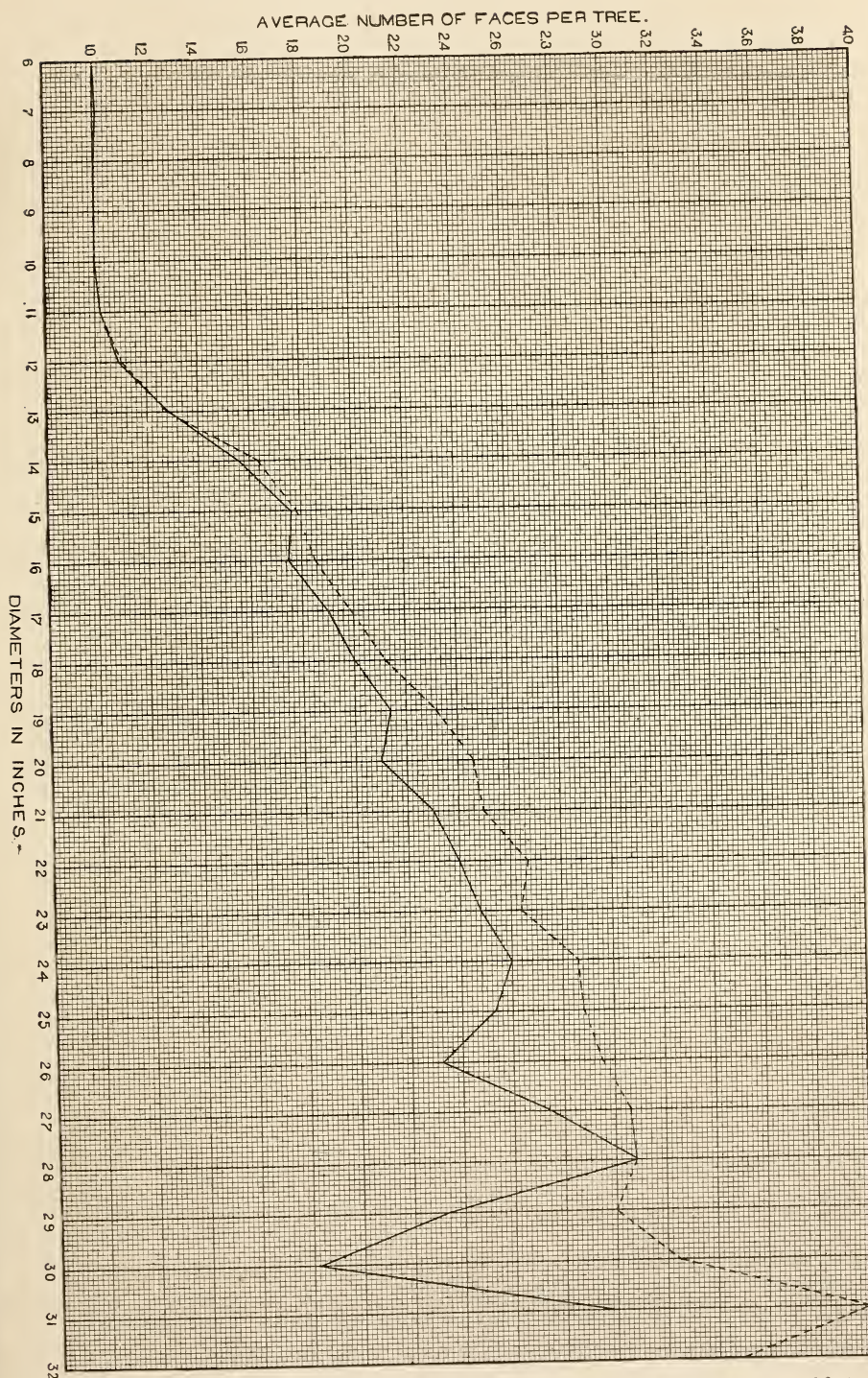


FIG. 4.—Diagram showing the average number of faces per tree in boxed and cupped halves of first-year crop. — Faces on boxed trees. - - - Faces on cupped trees.

stantly increasing proportion of this surface gives now no resin. The unproductive area is called "dry face" or "dry streak," and the box is partly responsible for it. In selecting a position for the box the cutter seeks that portion of the base of the tree which protrudes the most, so that the box will be sure to catch the resin dripping from above. In most cases this spot lies just across an important root. By the cutting of the box the tree is practically deprived of this feeder. To show the relation between "dry facing" and boxing, accurate measurement was made after the sixteenth and thirty-second chippings of the dry face which had developed throughout the crop. The results are shown in the following table:

TABLE 10.—*Dry-face measurements.*

Half crop.	Total original running surface.	After 16 chippings.		After 32 chippings.	
		Dry face.	Percentage of dry face.	Dry face.	Percentage of dry face.
	<i>Inches.</i>	<i>Inches.</i>		<i>Inches.</i>	
Cups.....	64,132	4,840.2	7.55	6,795.5	10.60
Boxes.....	65,545.3	11,126.5	16.98	13,778	21.02

It appears evident, therefore, that box cutting greatly increases the tendency of the tree to dry face, but that boxing is not solely responsible for it. In this gradual decrease of the amount of running surface by dry facing is found a partial explanation for the increased yield, but only a partial one, since the increase was evident in the second dipping from this crop (Table 4) before dry facing had developed to any extent. It seems clear, therefore, that this increase is most largely due to the greater vitality of the unboxed trees.

Indeed, if the matter be carefully considered in the light of the facts, the conclusion is reasonable that the increased yield is due to greater vitality of the trees. A pine tree is not simply a storehouse, from which only a certain amount of resin can be drawn; on the contrary, it is a living, growing organism, containing a large number of small resin manufactories—the resin ducts. Whatever tends to sustain the activities of the tree keeps these little resin factories working to their full capacity, and whatever injures the tree cuts down their output. It is necessary to wound the tree by chipping in order to open the resin ducts. The box cut in the base of the tree is an additional, severe, and unnecessary wound. The account books of an operator will show that he pays $1\frac{1}{2}$ cents for each box cut; the results obtained at Ocilla show that to this $1\frac{1}{2}$ cents must be added the value of at least 20 per cent of the resin flowing from the scarified face above that box even in the first year of the work, wasted without the slightest profit either to the turpentine operator, the timber owner, or the laborer.

SECOND, THIRD, AND FOURTH YEAR CROPS.

In turpentine operating the chipping is continued three and frequently four years. No complete comparison of the relative yield from the cup and from the box system can be obtained until the present first-year crop becomes successively a second, a third, and a fourth year crop. However, there are sources of loss in the later years of work under the boxing system other than the decreased productivity due to cutting the box. The constantly increasing length of the face gives increased opportunity for, first, evaporation of spirits of turpentine from the fresh resin as it flows to the box; second, formation of "scrape;" third, discoloration of the rosin obtained from the dip; and fourth, waste due to the resin failing to drop from the peak into the box, the effect either of the wind or the slant of the tree. All of these sources of loss, due solely to the length of the face, can be avoided in the cup system by raising the gutters and cups at the close of each season to within a few inches of the chipping surface.

To carry further the test of the relative merits of the two systems, three crops of boxes (10,500 each) were counted out which had been previously chipped one, two, and three seasons, respectively. On one-half of each of these crops, and in adjacent drifts, cups and gutters were placed. On the other half the resin was collected in the boxes as usual. The equitable division of the crops between cups and boxes was decided by the woodsman in charge of each crop. The results from the three crops are given in the following tables:

DIPPINGS.

TABLE 11.—*Second-year crop—thirty chippings.*

Cups.				Boxes.			
Number.	Date.	Barrels of dip.	Spirits of turpentine on distillation.	Number.	Date.	Barrels of dip.	Spirits of turpentine on distillation.
			<i>Gallons.</i>				<i>Gallons.</i>
1.....	Apr. 9	9½	90.5	1.....	Apr. 22	14½	156.0
2.....	May 8	17½	196.9	2.....	May 20	16	189.0
3.....	June 5	18	203.2	3.....	June 18	12½	144.2
4.....	July 2	15½	166.5	4.....	July 16	12	131.0
5.....	Aug. 9	20	199.4	5.....	Aug. 28	16	175.0
6.....	Oct. 3	16½	175.3	6.....	Nov. 6	a 14	146.6
Total.....		101½	1,087.2	Total.....		85	941.8

a Dipped after scraping.

TABLE 12.—*Third-year crop—thirty chippings.*

Cups.				Boxes.			
Number.	Date.	Barrels of dip.	Spirits of turpentine on distillation.	Number.	Date.	Barrels of dip.	Spirits of turpentine on distillation.
			<i>Gallons.</i>				<i>Gallons.</i>
1.....	Apr. 25	9½	103.5	1.....	Apr. 28	9	85.3
2.....	May 29	15¼	177	2.....	June 11	11¼	135.1
3.....	June 26	10½	120	3.....	Oct. 27	a 16¼	161.5
4.....	Aug. 1	12¼	131.8	Total.....		36¼	b 381.9
5.....	Sept. 15	11¼	123.2				
6.....	Oct. 23	7½	71				
Total		67¼	726.5				

a Dipped after scraping.

b The total spirits of turpentine from dip in the third-year boxes is less for the full season than the amount given by the writer on September 10, 1902, in an address before the Turpentine Operators' Association at Jacksonville, Fla. In order to give at Jacksonville the results as "spirits to date," the woodsmen had been requested to inspect all sets of cups and boxes carefully and to furnish an estimate of the dip in them at that time. Immediately after the writer's return from Jacksonville to Ocilla, the woodsman in charge of the third-year crop informed him that in estimating the box dip in the third-year crop he had by mistake given in an estimate for a full crop instead of for a half crop.

TABLE 13.—*Fourth-year crop—twenty-seven chippings.*

Cups.				Boxes.			
Number.	Date.	Barrels of dip.	Spirits of turpentine on distillation.	Number.	Date.	Barrels of dip.	Spirits of turpentine on distillation.
			<i>Gallons.</i>				<i>Gallons.</i>
1.....	Apr. 18	6⅞	79.3	1.....	May 15	13	128.8
2.....	May 19	13	152.1	2.....	July 13	12	128
3.....	June 20	11½	134.3	3.....	Oct. 20	a 9¼	92.7
4.....	July 21	10¼	119.7	Total.....		34¼	349.5
5.....	Sept. 22	11¼	134.8				
6.....	Oct. 17	6½	67				
Total		60¼	687.2				

a Dipped after scraping.

TABLE 14.—*Scraping.*

Half crop.	Net weight of scrape.	Spirits of turpentine on distillation.	Excess spirits of turpentine (boxes).
	<i>Pounds.</i>	<i>Gallons.</i>	<i>Gallons.</i>
Second year:			
Boxes	17,120	267	78.8
Cups	12,210	188.2	.....
Third year:			
Boxes	8,580	147.5	34.5
Cups	7,200	113	.....
Fourth year:			
Boxes	7,970	124.5	23.5
Cups	6,635	101	.....

TABLE 15.—*Net rosin sales.*

Half crop.	From dip.	From scrape.	Total.	Excess.
Second year:				
Cups.....	\$266.34	\$49.25	\$315.59	\$144.13
Boxes.....	104.51	66.95	171.46	.....
Third year:				
Cups.....	171.27	27.44	198.71	132.65
Boxes.....	39.49	26.57	66.06	.....
Fourth year:				
Cups.....	167.33	29.23	196.56	132.56
Boxes.....	36.09	27.91	60.00	.....

In the preliminary work at Statesboro, Ga., during the preceding year, it had been demonstrated that "water white" rosin (the highest grade) could be obtained from fourth-year trees if precautions were taken to collect the resin before it flowed over the exposed face left by the chipping of former seasons. It was a matter of surprise, therefore, when on distilling the first charge of fourth-year cup dip at Ocilla, "window-glass" rosin (the second highest grade) was obtained instead of "water white;" and this in spite of the seeming extreme purity of the dip. To test whether the fault might not have been with the distiller, it was decided to have the second dipping from these cups run by a distiller of wide reputation. Again only "window-glass" rosin was obtained, and the grading was confirmed later by the official gradings furnished by the Southern Naval Stores Company. This slight lowering of the grade of the rosin was undoubtedly due to the resin flowing over that portion of the old "lightwood" face lying between the chipping surface and the gutters at the beginning of the season.

As the season advanced there was a gradual deterioration in the grade of the rosin from all three sets of cups, the common experience in "virgin" crops of boxes.

COST OF CUP EQUIPMENT FOR ONE CROP.

The first cost per crop of equipping with the cup and gutter system is as follows:

Cups (10,500, at 1¼ cents)	\$131.25
Gutter stripping (1,886 pounds of galvanized iron, 29 gauge, cut in 2-inch widths)	103.27
Nails (6-penny wire nails)	1.05
Freight charges (estimated).....	30.00
Labor at tree.....	80.00
Cutting and shaping gutters.....	4.00
Total	349.57

The prices above quoted are those at which responsible firms will furnish the material required by the cup system. If the cups be placed

on old boxes, the item of labor should be reduced to \$30 per crop, the chipping of the previous season furnishing without further labor the flat surface for the gutters which slide into the incisions on old faces more readily than on freshly exposed sapwood. The estimated freight charges are based on a material reduction in freight rates on the equipment recently offered by the principal railroads in the turpentine belt.^a The motives prompting this offer were a desire to preserve the timber along the several lines and the conviction that by the use of such equipment the railroads would receive larger quantities of naval stores to haul.

The increased profits per crop under the cup system were shown by Table 3, p. 20, to range from \$341.54 for the second-year crop to \$516.48 for the fourth-year crop. In other words, the cost of the equipment is more than paid for during the first year and a handsome balance of profit left.

In the case of the first-year crop there should be added the amount saved from box cutting and cornering, increasing the profit by \$200. Clearly it is to the operator's advantage to place cups on virgin timber even more than on old boxes.

DIVISION OF LABOR.

ON VIRGIN TIMBER.

Three pairs of workmen (right-handed and left-handed) lead the squad, cutting the flat faces for the gutters with cornering axes. They work in a line across the drift, one pair on each side and one pair in the middle. These men are followed by a right-handed and a left-handed laborer, who make the incisions with broadaxes for the gutters. The broadax men work back and forth across the drift in narrow lines. Immediately following them are eight guttermen, each provided with a gutter box containing a supply of gutters of different lengths, nails, and a claw hatchet. The guttermen, who are placed at intervals across the drift, insert the gutters before the incisions begin to close, drive the nail, and hang the cups.

ON OLD BOXES.

Here the six laborers with the cornering axes are unnecessary. The chipping of the previous season furnishes the proper face for the gut-

^a The following railroads have agreed to haul the equipment as Class P matter, in carload lots, 24,000 pounds minimum car: Atlantic Coast Line Railroad Company; Central of Georgia Railway Company; Georgia Railroad; Georgia, Florida and Alabama Railway Company; Georgia, Southern and Florida Railway Company; Macon and Birmingham Railway Company; Seaboard Air Line Railway; Southern Railway Company; Western and Atlantic Railroad; Wrightsville and Tennille Railroad Company; Atlantic and Birmingham Railroad. This rate became effective on November 10, 1902.



EXTRA CUPS REQUIRED ON VERY PRODUCTIVE TREE.

FIG. 1.—WASTE OF RESIN ON UNDER FACE, DUE TO SHALLOW
INSERTION OF GUTTERS AT CENTER OF FACE.

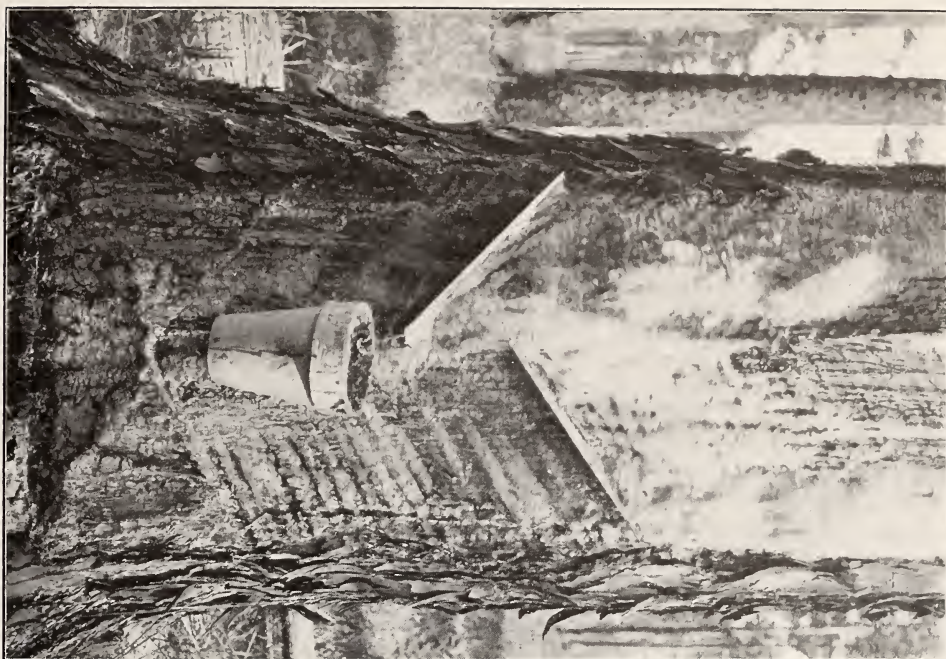
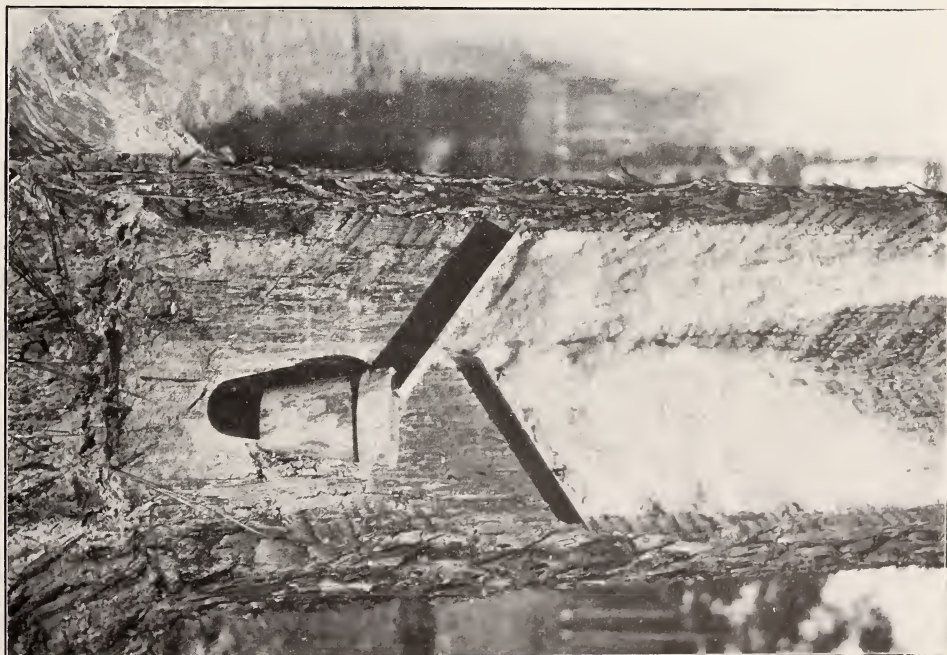


FIG. 2.—CLEAN UNDER FACE, RESULTING FROM DEEP INSERTION OF
GUTTERS AT CENTER OF FACE.



ters. The remainder of the work is the same as on virgin timber. In each case the best labor available should be assigned to the axes. If this work be well done there is no difficulty in the gutter work.

CUPS.

SIZE AND FORM.

The cup used at Ocilla during the past season was purposely made small in order that it might be easily handled by the dippers. It was found, however, that the use of the small cup caused much extra work, for it was necessary to hang extra cups on many of the faces during May and June. Indeed, in the first half crop of 5,217 faces 3,058 extra cups were used. At regular intervals the full cups were exchanged for the empty.

The cup recommended for future use has the following dimensions:

Inside measurements:	Inches.
Top	5½
Bottom	3
Height	7
Rim	2
Nail hole (diameter, placed one-half inch from top of rim).....	½
Thickness of side walls	¼
Oval bottom inside.	

Such a cup, twice as large as the cup used last year, has the same capacity as a standard box. The dippers agree that the oval bottom of the cup permits more rapid dipping, and they experienced no difficulty in handling the larger cup.

The cup is hung from the nail hole, and on one side of the center of the face (see frontispiece), so that the resin dripping from the spout above falls near the wall of the cup and well away from the nail hole. This is of great practical importance, for when the cups are filled with rain water, the fresh resin, lighter than water, drops on the surface and forms a circle there. As this floating disk spreads out it soon touches the wall of the cup, and, if the latter is properly placed, becomes anchored to it before reaching the nail hole. More resin dropping on this circle does not enlarge it, but causes it to pack down along the inner wall of the cup until it reaches the bottom, aided by the constantly increasing specific gravity of the resin. Meanwhile each drop of resin forces out a drop of water through the nail hole. After the streak has practically ceased running, the resin in the cup is protected from evaporation of its spirits of turpentine by the water above.

MATERIAL FOR CUPS.

Iron and tin rust too badly to make good cups; they are also too expensive, as are zinc, galvanized iron, and wood pulp. A good stone-ware cup answers every purpose, and is cheap.

Glazing the inside of the cups has been found to be entirely unnecessary if good potter's clay is used in their manufacture. No absorption of the resin takes place, nor is the cup affected by the resin.

GUTTERS.

BEST MATERIAL.

During the past season the gutters used were made of 28-gauge galvanized iron; 29-gauge is cheaper, but more difficult to secure in large quantities. Experiments have also been made with thin sheet iron, roofing tin (leaded), and double-dipped tin. The iron soon proved to be unsuitable; it rusted quickly, discoloring the water and resin in the cups. Whether or not this discoloration would result in a darker resin can not be stated, for no facts are at hand on which a judgment can be based. The cost of double-dipped tin is so nearly the same as that of the galvanized iron that it has no special advantage. The leaded roofing tin is cheaper, and showed during one season's work remarkably little rusting. That part of the gutter over which the resin flows is protected. These gutters are at present lying on the ground at the bases of the trees on which the experiments were made, in order to test further the question of rusting. These tin gutters are very easily and firmly placed in the incisions made by broadaxes. On account of their thinness it was feared that in removing them at the end of the season they would probably bend so much as to make it difficult to place them a second time; but by the use of a pair of large horseshoe nail pullers they can be easily removed without the slightest trace of bending. Certainly this material deserves further testing. Its successful use would materially decrease the first cost of the equipment.

FORM OF MATERIAL.

On account of variations in the size of timber in different sections, it is unquestionably better to purchase the gutter material, No. 29 gauge galvanized iron, in long strips, 2 inches wide. These can be subsequently cut, according to need, into desired lengths, varying from 6 to 12 inches. For this purpose a pair of No. 8 tinner's snips can be used, care being taken in cutting to prevent the turning of the corner where the cut is first made. Of this 2-inch stripping 1,886 pounds suffice for one crop of 10,500 cups.

SHAPING GUTTERS.

After the gutters are cut it is necessary to bend them to an angle of about 120° along their full length. No expensive apparatus is needed for this bending. A simple wooden machine was used at Ocilla for this purpose which cost only 75 cents. (See fig. 5.) The flat gutter is dropped into the narrow slit and the lever pulled forward until the

motion is stopped by the beveled edge. The bent gutter is then removed. A few minutes' practice enables a boy to bend from 20 to 25 gutters per minute.

GUTTER BOXES.

The gutters, in lengths varying from 6 to 12 inches, are carried by the gutter men in boxes with sloping sides, containing partitions for the several lengths. (Pl. VII, figs. 1 and 2.)

PLACING GUTTERS.

The placing of gutters is not so simple as it appears at first glance. This is because of the roughness of the face cut by the cornering ax and the formation of scrape in the gutters. If turpentine were a watery solution the matter would be simple, for the flow of such a liquid could be told in advance; but the solidification of the resin in the gutters gives quite an unexpected direction to the flow on subsequent chippings. The following points should therefore be carefully guarded in placing gutters:

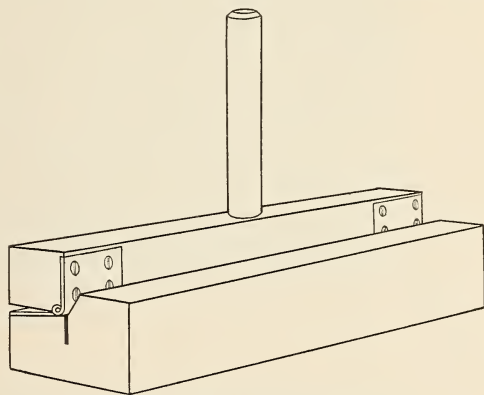


FIG. 5.—Device for shaping gutters.

(1) The gutter must pass beneath the wood at every point along the full width of the face; otherwise there will be a leakage behind it.

(2) The upper and lower gutters must be at least 1 inch apart at the center of the face, so that there may be no choking at the center by the scrape.

(3) The upper gutter should come to the center of the face, and should not project more than one-quarter of an inch beyond the center.

(4) The projection of the lower gutter beyond the center of the face, the "spout," is absolutely essential to the successful working of the apparatus.

(5) Care must be taken that both gutters be placed well under the wood at the center of the face. (Pl. X, figs. 1 and 2.)

Some trouble was experienced in the early part of the season from the falling out of gutters on very small trees in the fourth-year crop. It was impossible to decide whether this was due to the swaying of the trees and the consequent opening of the cuts on these high faces, or to the single-beveled broadaxes used in this crop.

TOOLS FOR PLACING EQUIPMENT.**CORNERING AX.**

This ax, common on all turpentine places, was found serviceable for making the flat faces for the gutters on round timber. Various substitutes were tried, but none with success.

BROADAXES.

Two broadaxes with 12-inch straight edges are set on short, straight handles for a right-handed and a left-handed cutter.

On old faces it was found that the stock broadax, beveled only on one side, would not answer. The straight side makes a smooth, but the beveled side a rough, cut. Such an incision will not close firmly on the gutter. The substitution of a broadax beveled on both sides gave a cut smooth on both sides and answered all purposes admirably. No such ax can at present be bought on the market, but the extra bevel can be placed on a single-beveled ax with a good emery wheel, care being taken not to affect the temper of the steel. On virgin timber the single-beveled ax makes in the freshly exposed sapwood a cut clean on both sides, and therefore answers every requirement for the first-year crop. The skill of the turpentine laborer with the broadax is remarkable. Only a few strokes are required to give him perfect control of the new operation. Two men should be able to cut 3,000 faces per day.

It is of importance that in using the broadaxes the head of the ax be turned down only slightly in making the cut, otherwise the inner half of the gutter has too much slope, and, upon the formation of scrape in the gutter, the resin from a fresh chipping wastes over the outer edge.

CLAW HATCHET.

This is the only tool required for the gutter men, as it serves for tapping the upper end of the gutter in case of jamming in the incision, for driving the nail on which the cup is hung, and for removal of bark, etc., in order to hang the cup properly. At the close of the season the same hatchet may be used for removing the gutters.

OPERATING WITH THE EQUIPMENT.**CHIPPING.**

No change whatever is required in this part of the work. The upper gutter is placed about 3 inches from the chipping surface, giving abundant space for the passage of the hack. This distance is really greater than is necessary, for the writer has seen trees chipped with entire ease and safety within 1 inch of the gutter. The concession was made, however, to the chippers at Ocilla, in order that there



FIG. 1.—CHIPPING FIRST-YEAR CUPPED TREE.



FIG. 2.—CHIPPING SECOND-YEAR FACE (TREE BOXED ONE SEASON).



FIG. 1.—“PULLING” (CHIPPING) FOURTH-YEAR FACE (TREE BOXED THREE SEASONS).



FIG. 2.—DIPPING FOURTH-YEAR CUPS.

might be no difficulty in beginning the work. The fear of striking the hand against the sharp corner of the gutter proved to be groundless. It is only necessary to be a little careful on the first few chippings; afterwards the presence of the equipment is not noticed by the chipper. There is no danger of breaking the cups with the hack weights. The inclination of the gutters gives a sufficient distance between the hack and the cup to insure perfect safety. This is well shown on Pl. XI, figs. 1 and 2.

On the first chipping during the past season great difficulty was experienced from chips falling into the cups during chipping. This matter, however, soon remedied itself. The chippers found that by using a long stroke, especially at the peak, the chip could be easily thrown away from the cup. The distiller at Ocilla states that the dip from the first-year and second-year cups contained as a rule about half the amount of chips usual from first and second year boxes.

PULLING.

Here, again, no change whatever is made in the usual labor (Pl. XII, fig. 1); the puller passes easily between the gutter and the streak, and naturally carries the chip past the center of the face. The resin from cups on old faces is freest of all from trash. A charge of fourth-year cup dip needs practically no skimming before distillation.

DIPPING.

TOOL USED.

The tool used for dipping the cups is a steel blade, which can be made from an old saw, 8 inches in length, 2 inches across the lower end, and 4 inches at the upper end. In the case of an oval-bottomed cup, the lower edge of the dipper should be slightly rounded to fit it. This blade, by means of a shank, is fastened to a wooden handle.

METHOD OF DIPPING.

In dipping, the accumulated scrape is first removed from the gutters by means of this "dip knife," the scrape being shoved down into the cup. The cup is then removed from the nail and the resin cut from the walls of the cup by the dip knife and emptied into the bucket. (Pl. XII, fig. 2.) The dippers found that if the cup were not allowed to move in the hand it was an easy matter to replace it on the nail after dipping. During the entire past season only three cups were broken in dipping, and these in the early part of the season, making it probable that they were defective at the outset.

COST OF DIPPING.

It is impossible to give an accurate figure for the cost of dipping under the cup system, for two reasons. In the first place, on account

of the smallness of the cup used at Ocilla, many extra cups were required, which increased the work of dipping. Secondly, the cups had a flat inside bottom, and the judgment of the dippers is that it required more time to remove the gum completely from the flat-bottomed than from an oval-bottomed cup. In spite of these difficulties, however, the dippers, paid by the day, dipped from 2 to 3 barrels per day. Mr. Powell and the woodsmen think that with the larger oval-bottomed cup there will be no difficulty in having the cups dipped at $33\frac{1}{2}$ cents per barrel, the present price for dipping boxes.

REMOVAL OF EQUIPMENT.

FROM HIGH FACES.

At the close of the chipping season and before scraping it is necessary to remove the equipment on all crops. In this work the cups are first dipped and laid on the ground just to the side of the face. The gutters and nails are then removed, the former having been cleared of scrape by the dipper. Each gutter is laid on the ground just in front of the face to which it belongs. In case the equipment is to be moved to another crop, the gutters are collected in boxes and piled at convenient points for subsequent removal. At Ocilla it was expected to draw the gutters from the faces of the trees by means of a pair of pliers. This, however, proved impracticable. On high faces the use of a hammer with a narrow claw was found best for the purpose. The method of using the hammer is shown on Pl. XIII. After placing the claw of the hammer over the gutter the latter is removed by a sharp, quick pull. In only a few cases did the gutters bend as a result of this pull. (Pl. XIV.)

FROM LOW FACES.

In the case of the first-year and second-year gutters, a pair of large horseshoe nail pullers were used very successfully. The jaws of the tool are placed along the length of the gutters, midway between the two ends, and as near the face of the tree as possible. By a slight pull the gutter is easily removed. In no case was a gutter bent while this tool was in use. The nail is drawn with the same tool.

The fact that it is necessary to draw the nail in order to scrape the face makes its use unobjectionable to sawmill owners.

COST OF REMOVAL.

The actual cost of removing the half crop of first-year gutters and nails was \$2.35, the labor estimated at 10 cents per hour. On first-year and second-year trees young boys could be utilized for this work, thus reducing the cost by nearly 50 per cent.

COST OF RAISING THE EQUIPMENT.

With the equipment distributed at each face, and with the flat surfaces for the gutters already provided by the chipping of the past season, it is safe to say that the cost of raising the equipment for the next season's work will not amount to more than \$30 per crop, and in all probability will be less than this amount. No definite figure can be given, however, as this work remains yet to be done at Ocilla.

SCRAPING.

SCRAPE BOX.

After the removal of the cups, gutters, and nails, the labor in scraping is the same as formerly. The only change is in the scrape box. Under the box system the scrape box rests on the lip of the box and projects under the face of the tree. This serves to prevent waste of small particles of scrape. Under the cup system a slight modification of the scrape box was made, as shown on Pl. XV. Two strips of wood were nailed to the sides of the scrape box, projecting about 6 inches in front. On these strips and along the front edge of the bottom of the scrape box a stout piece of cloth is tacked, drawn taut where it touches the box, but left rather loose along its forward edge. As the scrape box is placed against the tree, the cloth adapts itself to the form of the face, fitting closely and thus avoiding waste, while the weight of the box is not on the cloth, but on the front edge of the box, which lies against the tree. This form of scrape box proved very effective at Ocilla, the laborers being delighted with it, and inspection of the ground after scraping showing much less than the usual amount of waste scrape.

SCRAPING THIRD-YEAR AND FOURTH-YEAR TREES.

The scraping of the trees of the third-year and fourth-year crops was much easier work than in the corresponding box faces, for the scrape is confined to the upper portion of the face, making thus a much smaller surface to be scraped. It is of interest to note (Table 2 and Table 14) that, while more scrape was obtained from the box halves of the crops than from the cup halves, the net sales of the rosin made from this scrape showed an excess value from the cup halves, on account of the higher grade of the rosin.

DISTURBANCE OF EQUIPMENT.

Many predictions were made concerning the fate of the equipment after it should be in place on the trees.

No fairer test could have been made regarding interference with the equipment than was made in the first-year crop. Through this crop run three roads, constantly in use, one of these being the principal

roadway of the county. Along these roads many cups were placed so close to the road that they could easily be reached by a buggy whip. During the first two weeks after placing the equipment about ten cups were broken in the first cup drift. No threats were made, but the broken cups were quietly replaced by new ones, and the trouble ceased. In another part of the crop were some of the shanties of the mill workmen. Cups were placed all around these houses, but during the entire season not one was disturbed.

This tract of timber was the grazing ground of all the cattle belonging to a large lumber company. At the beginning, a few of the cups were knocked off by the cattle, but inspection showed that in every case this had happened where a finishing nail, without a head, had been driven into the tree horizontally. The error in driving the nail was corrected, and the cups were afterwards undisturbed.

Hogs were constantly in these woods, but gave no trouble.

HEIGHT OF EQUIPMENT.

Special effort was made at Ocilla to place the first-year cups near the ground, in order to eliminate, as far as possible, any question except that of box or no box. As the season advanced and fuller opportunity was given to study the working of the equipment, one of the woodsmen suggested that it would be better to place the cups on first-year crops somewhat higher above the surface of the ground. The writer agrees thoroughly with this suggestion. At the base of many pines the tree slopes, causing the cup to lean toward the tree, thus decreasing its capacity: the work with the axes and gutters would certainly be easier in the more elevated position: the resin in the cups would be freer from sand and dirt blown in by winds; and, finally, by leaving the base of the tree uncut it is probable that a slightly larger yield of crude turpentine would be obtained. There are no facts, however, to make this latter statement more than a matter of opinion.

Following this increased elevation of the cup in the first year, it was further suggested that the streak be turned to the puller during the last few weeks of the second year. Thus the gutters could be placed closer to the streak in the third year, with the result that a better grade of rosin would be obtained, and less trouble would be experienced with labor in the third year, a trouble common to both cups and boxes.

DAILY FLOW OF RESIN.

To gain a more accurate idea of the flow of resin from a fresh streak, three of the best trees in the first-year crop were selected—a Hill Pine, a Slash Pine, and an Old Field Slash Pine—all situated near each other. At 9 o'clock on the morning of July 1 a fresh streak was chipped on each of these. Immediately after chipping an empty weighed cup was hung. At 9 o'clock each morning during the fol-



REMOVING GUTTERS FROM FOURTH-YEAR FACES.



DRAWING NAILS FROM FOURTH-YEAR FACES (OLD BOX BURNED OUT BY GROUND FIRES).



"SCRAPE BOX" FOR GATHERING SCRAPE FROM UNBOXED TREES.

lowing week these cups were weighed at the tree, the increase in weight over that of the previous day representing the flow of resin during the preceding twenty-four hours. At the end of a week the Old Field Slash Pine was still producing resin. It was therefore decided to continue the weighings from this face another week, no fresh streak being chipped. The results obtained are given in the following table, the weights being expressed in grams, 454 grams making a pound:

TABLE 16.—*Daily flow of resin.*

Date.	Old Field Slash.	Slash.	Hill Pine.
	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>
July 1...	289	254	523
July 2...	187	65	144
July 3...	109	20	31
July 4...	86	6	13
July 5...	103	8	12
July 6...	90	7	14
July 7...	87	9	3
July 8...	68	.....	.....
July 9...	69	.....	.....
July 10...	72	.....	.....
July 11...	47	.....	.....
July 12...	48	.....	.....
July 13...	39	.....	.....

This table shows a total of 951 grams (2.1 pounds), or about 1 quart, of resin from one chipping on Old Field Slash in seven days. And this is repeated from week to week throughout the hot season. When the volume of sapwood removed by each weekly chipping is considered, what better proof could be offered for the statement made previously that a pine tree is not simply a storehouse but also a resin manufactory?

COMPARISON OF RESIN FROM BOXED AND UNBOXED TIMBER.

On June 10, 1902, a careful comparison on a commercial scale was made of the resin from the first-year cups with that from the first-year boxes. In this test 10 barrels of cup dip and 10 barrels of box dip were used. The net weight of the dip (including water and trash) for each charge was determined. After distillation weighings were made of the spirits of turpentine, rosin (net weight), and trash. The difference between the sum of these three weights and the weight of the dip used represented the water present in the dip. Calculating the spirits of turpentine and rosin on a basis of dip free from water and trash, there was found:

	Cups.	Boxes.
	<i>Per cent.</i>	<i>Per cent.</i>
Spirits of turpentine	22.70	23.11
Rosin.....	77.30	76.89

This close agreement in a test, necessarily roughly made, shows that there is no difference in the quality of the resin from boxed and unboxed timber in the virgin year. A confirmation of this experiment is shown in Tables 1 and 2, the excess per cent of spirits of turpentine from the cupped half of the first-year crop, 23.43 per cent, agreeing closely with the excess net sales of rosin, 23.50 per cent.

CONCLUSION.

PROGRESS RESULTING FROM THE INVESTIGATION.

The experiments during the past season have abundantly justified the statement previously made that the box is an "unnecessary wound," for the cup system has proved efficient in the hands of the regular turpentine labor, while the increased profits under this improved system are sufficient to warrant its adoption by any turpentine operator, regardless of all questions connected with the future of the naval-stores industry.

It is gratifying to note that the prospects for the adoption of the system during the next season are bright. Potteries have been established for the manufacture of the earthen cups, and it appears that the extent of the use of these will be limited only by the capacity of the potteries. Nor is interest in the new system confined to the operators. The timber owners throughout the turpentine belt are awakening to the fact that such a change in the system of operation is of equal importance to them. In several instances leases have already been extended, conditioned upon the use of cups. Furthermore, tracts of timber hitherto unavailable for boxing have been offered for lease with the proviso that the cup system be used. The investigation has already borne fruit.

FUTURE INVESTIGATIONS.

Much more remains to be done. The universal adoption of the cup system would not in itself perpetuate the naval stores industry, for the girdling of trees, so fatal in its effects, is just as possible under the one system as under the other. But the demonstration that unboxed timber at Ocilla yields $23\frac{1}{2}$ per cent more crude turpentine than boxed timber establishes clearly the dependence of the productiveness of the tree upon its vitality. This fact clearly points the way to future investigation. May it not be possible—indeed, is it not probable—that the removal of less of the sapwood by chipping, both as to width and depth, would result in increased production? If this be true, to what extent can it be carried under present economic conditions? No categorical answers can be given to these questions, for no facts are at hand on which such an answer can be based. Systematic investigation is demanded, and will be prosecuted as rapidly as possible.

A strong hope for the future lies in the fact that under the cup system the point of view of the operator will be completely changed. Under the box system he can obtain pale rosins and a large yield of crude turpentine only in the first season of operation. Consequently there is now a constant necessity for bringing virgin timber under operation. From such first-year boxes the operator expects his largest returns, gaining a somewhat smaller yield in the second year, and content to get whatever he can in the third and fourth years. With the cup system, under which only pale rosins are obtained, and the waste of the later years avoided, he will think more and more of the possibilities of these later years, in the end reap a much greater profit, and at the same time do far less injury to the forests of Longleaf Pine, upon whose preservation depends the existence of the naval-stores industry.

ACKNOWLEDGMENT.

For the preliminary investigation at Statesboro, Ga., the writer makes grateful acknowledgment to Messrs. John R. Young, W. C. Powell, J. P. Williams, and J. B. Chestnutt, of Savannah, Ga., who guaranteed the expense of the work; to Messrs. McDougald & Co., of Statesboro, Ga., who furnished the timber, and to the Central of Georgia Railway Company, the Southern Railway Company, the Seaboard Air Line Railway, the Plant System of Railways, the Atlantic, Valdosta and Western Railway, and the Tifton, Thomasville and Gulf Railway for transportation courteously granted.

For the more extended investigations at Ocilla, Ga., the writer expresses to Messrs. Powell, Bullard & Co., on whose place the experiments have been conducted, and especially to Mr. John H. Powell, manager, and all associated with him at Ocilla, sincere appreciation of the uniform courtesy extended and the hearty cooperation shown throughout the progress of the work. A full season has passed, leaving nothing but good will and mutual understanding.

Thanks are also due to the Southern Naval Stores Company, of Savannah, Ga., which furnished separate sales sheets of the rosin from each of the eight half crops under investigation, to President John M. Egan, of the Central of Georgia Railway, and to Mr. S. F. Parrott, of the Southeastern Freight Association, whose interest was most largely responsible for the material reduction in freight rates on cups and gutters recently offered by the principal railroads in the turpentine belt.

The constant support given to the work by the press throughout the South has been of great service in building up a public sentiment for the introduction of more conservative treatment of the Longleaf Pine forests.

* NATIONAL AGRICULTURAL LIBRARY



1022512184

NATIONAL AGRICULTURAL LIBRARY



1022512184